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Plus-Minus-Interesting Exercises To Encourage Student Reflection

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Abstract
It can be difficult to include time for reflection in a problem-solving course, and even more difficult to ensure that students reflect on their problem-solving strategy in a meaningful way. We have found the "plus-minus-interesting" or PMI scheme, to be a quick and effective framework for structuring brief, in-class reflection exercises that are completed by teams of students.

Disciplines
Engineering Education

Comments
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This one-page column will present practical teaching tips in sufficient detail that ChE educators can adopt the tip. The focus should be on the teaching method, not content. With no tables or figures the column should be approximately 500 words. If graphics are included, the length needs to be reduced. Tips that are too long will be edited to fit on one page. Please submit a Word file to Phil Wankat <wankat@ecn.purdue.edu>, subject: CEE Teaching Tip.

PLUS-MINUS-INTERESTING EXERCISES TO ENCOURAGE STUDENT REFLECTION

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It can be difficult to include time for reflection in a problem-solving course, and even more difficult to ensure that students reflect on their problem-solving strategy in a meaningful way. We have found the "plus-minus-interesting" or PMI scheme,[1] to be a quick and effective framework for structuring brief, in-class reflection exercises that are completed by teams of students.

In the PMI method, a group is directed to evaluate an idea or a proposal by listing the plus (positive), minus (negative), and interesting (noteworthy, but neither positive nor negative) attributes or consequences of the proposed solution. The PMI activity encourages participants to approach new ideas with an open mind by examining the problem from different viewpoints before forming an opinion.

In our rendition of PMI, we use the method to help students see different approaches to solving a problem that they have just attempted themselves. For example, one of us uses this exercise during the second week of the semester in an introductory course to help students improve their written problem solutions. Three samples of student work that were submitted for the previous day's assignment are selected and photocopied (with names and scores removed). The samples include one solution each from the excellent, improving, and novice categories of the grading rubric. During class, each team is given the three samples, a copy of the grading rubric for that assignment, and three PMI evaluation worksheets. To guide the team discussions, the worksheets contain prompts for each category:

- *Plus describes aspects of the problem solution that are done well and would be useful for solving future problems.*
- *Minus describes parts of the problem solution that need improvement.*
- *Interesting describes items included in this problem solution that you had not considered in your solution.*

The teams review the problem solutions provided and complete a PMI worksheet for each sample. The exercise concludes with a short classroom discussion in which teams are called on to share one of their observations.

There are many ways to adapt this PMI exercise. With more advanced students, the instructor can provide samples of student work that show different (yet not necessarily wrong) solution approaches, and then ask the students to rank the samples in order of preferred approach after they have completed the evaluation. Another variation is to assign a problem to be solved in class by teams of students. Midway through the exercise, the instructor interrupts and asks the teams to pass their work to another team for a PMI evaluation. After five minutes, the original work and the evaluations are returned to the teams and the problem-solving exercise resumes. We have used PMI exercises in undergraduate and graduate courses alike.

Running a PMI exercise in class takes 15 minutes and accomplishes three things. First, it provides students with a structured opportunity to reflect on the problem-solving process. Second, it gives students practice at giving and receiving feedback. Finally, it gives the students a framework for future decision-making exercises in the course, elsewhere in the curriculum[2] (including experiential learning settings like internships, research projects, and design competitions), and throughout their professional careers.

REFERENCES

1. De Bono, E., *De Bono's Thinking Course*, Facts on File, New York (1994)
2. Adams, D.J., J.L., Beniston, and P. Childs "Promoting Creativity and Innovation in Biotechnology," *Trends in Biotechnology*, **27**, 445 (2009) ❐